UNIVERSITY OF SWAZILAND
DIPLOMA IN ENVIRONMENTAL HEALTH SCIENCE
FINAL EXAMINATION PAPER 2008

TITLE OF PAPER	:	**INTEGRATED BASIC SCIENCES**
COURSE CODE	:	**HSC 106**
TIME	:	**3 HOURS**
TOTAL MARKS	:	**100 MARKS**
INSTRUCTIONS	:	**THIS QUESTION PAPER HAS SIX QUESTIONS**
	:	**ANSWER FOUR QUESTIONS ONLY**
	:	**EACH QUESTION IS 25 MARKS**
	:	**AT LEAST TWO QUESTIONS MUST BE ANSWERED FROM EACH SECTION.**
	:	**A PERIODIC TABLE AND DATA SHEETS ARE PROVIDED WITH THIS EXAMINATION PAPER**
	:	**NO FORM OF ANY PAPER SHOULD BE BROUGHT INTO NOR TAKEN OUT OF THE EXAMINATION ROOM**
	:	**BEGIN THE ANSWER TO EACH QUESTION ON A SEPARATE SHEET OF PAPER**
	:	**ALL CALCULATIONS/WORKOUT DETAILS SHOULD BE SUBMITTED WITH YOUR ANSWER SHEET(S)**

DO NOT OPEN THIS EXAMINATION PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR

QUESTION 1 [25 MARKS]

a) Convert the following figures to the units indicated: [6]

i) 4.02 kg/L ..... g/ml
ii) 25 fm..... .....m
iii) 50 000 μg..... mg
iv) 4.8×10^{24} atoms..... ...moles
v) 90 pulse/min.....pulses/sec
vi) 20 oz/gal.....g/L

Recall: *1 minute = 60 secs* *1 oz = 28.4 g*
1 in. = 2.54 cm *1 gal = 3.8 L* $6.023 \times 10^{23} = 1 mole$

b) Carry out the following calculations and express each answer with the **correct number of decimal, significant figures and units**. [2]

i) 8.6742 g ÷ 0.00371 L =

ii) $\frac{3.41\,g - 0.02310\,g}{5.2331\,ml} * 0.2051\,ml =$

c) Write short notes explaining the differences between the following **pairs**:
i) Accuracy and precision [2]
ii) Systematic and random errors [2]

d) precise A patient was to be given 3.231 mg of de-worming tablets. Two doctors Mncedisi and Siphiwesihle weighed tablets five times to get the following readings:

Mcedisi	siphiwesihle
3.851	**3.217**
3.314	**3.193**
3.791	**3.208**
3.014	**3.226**
3.152	**3.301**

Calculate (for both Mncedisi and Siphiwesihle):
i) the mean [2]
ii) Standard deviation [2]
iii) % Coefficient of variation [2]
iv) % Relative error [2]

e) Which measurements from 2(c) above are the most ? [2]
i) accurate
ii) precise

f) What are the sources of error and what appropriate action would you take to prevent the errors in 1(e) above ? [3]

Useful Formulae:

$$standard\ deviation\ S_x = \sqrt{\frac{\sum_{i=1}^{N}\left(\bar{x} - x_i\right)^2}{N-1}};\quad mean\ \ \bar{x} = \frac{\sum_{i=1}^{N} x_i}{N}$$

QUESTION 2 [25 MARKS]

a). Explain the difference between Any Two of the following pairs of terms. Give examples for each pair.

i). Ionic bonding and Covalent bond [5]
ii). Co-ordinate bond and Metallic bonding [5]
ii). Octet Rule and the periodic Law [5]
iv). Compounds and elements [5]
v) Hunds rule and Agfbau builing up principle [5]

b). Draw Lewis structures or diagrams to show and name the type of bonding for each of the following: [3]

(i) H_2O

(ii)

$$NH_3 + BF_3 \rightarrow NH_3BF_3$$

(iii) CHCH

c) i) Using Hunds rule, Agfbau builing up principle and the periodic table write the electronic configurations of **any Two** of the following elements. [2]

ii) Also indicate their environmental hazards and most likely source of the **Two** you have chosen in c(i): [6]

Arsenic Lead Cadmium Mercury

d) (i) Define the Daltons' Atomic Theory. In your answer, using an example of your choice, explain the flaws (problem) with this theory. [3]

(ii) Given that the natural abundance of oxygen isotopes: ^{16}O is 99.76%, ^{17}O is 0.04% and ^{16}O is 0.20%, Calculate the relative atomic weight (in g/mole) of oxygen. [1]

QUESTION 3 [25 MARKS]

a) i) Define a buffer solution [2]
ii) Name three kinds of buffers found in the body. [6]

b) Briefly discuss **any one** of the following: [8]
i) Respiratory acidosis
ii) Metabolic acidosis

In your discussion include the cause, the symptoms and the treatment.

c) A 19 year old man is admitted to hospital.. On admission his laboratory results were as follows:

Blood pressure	90/20 mm Hg	Sodium	132mmol/L
Deep respirations	35/min	Potassium	6.5mmol/L
Pulse	120/min	pH	6.75
glucose	20 mmol/l	PCO_2	11 mm Hg
protein	100 μg/dl	Blood ketones	positive

i) Using the data given diagnose the condition of the patient, giving specific reasons for your diagnoses. [6]
ii) What treatment would you prescribe. [3]

Question 4 [25 Marks]

a) Define the difference between empirical and molecular formular [6]

b) Give three ways by which the empirical formula may be obtained. [4]

c) 6.853 mg of a sex hormone containing C, H and O was burned to determine its molecular formula. On burning 20.08 mg CO_2 and 5.023 mg of H_2O were obtained. The formula weight of the substance was found to be 270 g/mol.

i) Calculate the Empirical formula for the hormone [10]
ii) Calculate the molecular formula for the hormone [5]
[note that the unit 1 mg = 0.001 g = $1x10^{-3}$g]

Question 5 [25 Marks]

a) Given that 50 g sugar reacts with 25 g oxygen in combustion,
Find
i) the limiting reactant [3]
ii) theoretical yield in grams CO_2 [2]
iii) percetange yield if 5 g CO_2 is produced. [2]
ii) the number of oxygen atoms in 50 g sugar. [2]

Useful information: sugar is represented by the formular $C_6H_{12}O_6$

b) Using equations define the following terms:
i) Molarity [1]
ii) Normality [1]

c) If 4.09 g H_3PO_4 is dissolved in 250 mL solution calculate:
i) Number of equivalents of H_3PO_4. [2]
ii) The Normality of the Solution. [2]
iii) The molar concentration of the solution. [2]

d) An antacid tablet was given to a patient to relieve stomach discomfort. Given that the antacid was aluminium hydroxide, $Al(OH)_3$ which reacts with hydrochloric acid. How many grams acid in the stomach will 1.50 g antacid tablet neutralize ?[3]

e) Doctor Mncedisi is instructed to prepare 250 ml of a 15 % (w/v) of an antibiotic from a 30 % (w/v) solution.

i) What volume of antibiotic is needed to make the required antibiotic. What volume. [3]

ii) of water will be added to make the required antibiotic, explain how the solution is prepared. [4]

Question 6. [25 Marks]

a) Adenosine triphosphate (ATP) is an important substance in all living cells. A sample with mass of 0.8138 g was analysed and found to contain 0.1927 g of Carbon C, 0.02590 g of hydrogen H, 0.1124 g of Nitrogen N and 0.1491 g of phosphorus P. The remainder was oxygen. Its formula weight was determined to be 507 g/mol.

i) Define the difference between empirical and molecular formular [4]

ii) Calculate the Empirical formula (in the form $C_vH_wN_xP_yO_z$) of Adenosine triphosphate (ATP). [6]

iii) Calculate the Molecular formula of Adenosine triphosphate (ATP) [2]

b) 6.853 mg of a sex hormone containing C, H and O was burned to determine its molecular formula. On burning 20.08 mg CO_2 and 5.023 mg of H_2O were obtained. The formula weight of the substance was found to be 270 g/mol.

iii) Calculate the Empirical formula for the hormone [10]

iv) Calculate the molecular formula for the hormone [3]

[note that the unit 1 mg = 0.001 g = $1x10^{-3}$g]

NORMAL LABORATORY VALUES FOR BLOOD TESTS

	USUAL REFERENCE RANGE	
Specific Gravity		1.056
Hemoglobin Count Hb		Men: 14 - 18g /dL Women: 12 -16 g/dL
HCO^-_3 Bicarbonate	24 - 28 mmol/L	24 - 28 mEq/L
Glucose	(3.6-6.1 mmol/L)	65 - 110 mg/dL
BUN (Blood Urea Nitrogen)	2.9 - 7.1 mmol/L	8 - 20 mg/dL
Ca^{+2}	(2.1-2.6 mmol/L)	8.5 - 10.3 mg/dL
Cl^-	(96-106 mmol/L)	96 - 106 mEq/L
Cholesterol		150 - 220 mg/dL
CO_2	24-29 mmol/L	24-29 mEq/L
PCO_2		35-45 mmHg
PO_2		80 - 100 mm Hg
pH		7.35 - 7.45
Fatty acids	0.3-0.8 mmol/L	0.3-2 mg/dL
Protein		6-8 μg/dL
Phosphate	1 - 1.5 mmol/L	3-4.5 mg/dL
ketone bodies		0.3-2 mg/dL
K^+	3.5-5 mmol/L	3.5 - 5 mEq/L
Na^+	136-145 mmol/L	136 - 145 mEq/L
Uric Acid	Men: 0.18 - 0.54 Women: 0.15 - 0.46 mmol/L	Men: 3 - 9 mg/dL Women: 2.5 - 7.5 mg/dL Children: 1.5 g/L (150mg/dL)

PERIODIC TABLE OF ELEMENTS

GROUPS

PERIODS	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1.008 H 1																	4.003 He 2
2	6.941 Li 3	9.012 Be 4											10.811 B 5	12.011 C 6	14.007 N 7	15.999 O 8	18.998 F 9	20.180 Ne 10
3	22.990 Na 11	24.305 Mg 12											26.982 Al 13	28.086 Si 14	30.974 P 15	32.06 S 16	35.453 Cl 17	39.948 Ar 18
4	39.098 K 19	40.078 Ca 20	44.956 Sc 21	47.88 Ti 22	50.942 V 23	51.996 Cr 24	54.938 Mn 25	55.847 Fe 26	58.933 Co 27	58.69 Ni 28	63.546 Cu 29	65.39 Zn 30	69.723 Ga 31	72.61 Ge 32	74.922 As 33	78.96 Se 34	79.904 Br 35	83.80 Kr 36
5	85.468 Rb 37	87.62 Sr 38	88.906 Y 39	91.224 Zr 40	92.906 Nb 41	95.94 Mo 42	98.907 Tc 43	101.07 Ru 44	102.91 Rh 45	106.42 Pd 46	107.87 Ag 47	112.41 Cd 48	114.82 In 49	118.71 Sn 50	121.75 Sb 51	127.60 Te 52	126.90 I 53	131.29 Xe 54
6	132.91 Cs 55	137.33 Ba 56	138.91 *La 57	178.49 Hf 72	180.95 Ta 73	183.85 W 74	186.21 Re 75	190.2 Os 76	192.22 Ir 77	195.08 Pt 78	196.97 Au 79	200.59 Hg 80	204.38 Tl 81	207.2 Pb 82	208.98 Bi 83	(209) Po 84	(210) At 85	(222) Rn 86
7	223 Fr 87	226.03 Ra 88	(227) **Ac 89	(261) Rf 104	(262) Ha 105	(263) Unh 106	(262) Uns 107	(265) Uno 108	(266) Une 109	(267) Uun 110								

Atomic mass → 10.811
Symbol → B
Atomic No. → 5

TRANSITION ELEMENTS

*Lanthanide Series	140.12 Ce 58	140.91 Pr 59	144.24 Nd 60	(145) Pm 61	150.36 Sm 62	151.96 Eu 63	157.25 Gd 64	158.93 Tb 65	162.50 Dy 66	164.93 Ho 67	167.26 Er 68	168.93 Tm 69	173.04 Yb 70	174.97 Lu 71
**Actinide Series	232.04 Th 90	231.04 Pa 91	238.03 U 92	237.05 Np 93	(244) Pu 94	(243) Am 95	(247) Cm 96	(247) Bk 97	(251) Cf 98	(252) Es 99	(257) Fm 100	(258) Md 101	(259) No 102	(260) Lr 103

( ) indicates the mass number of the isotope with the longest half-life.